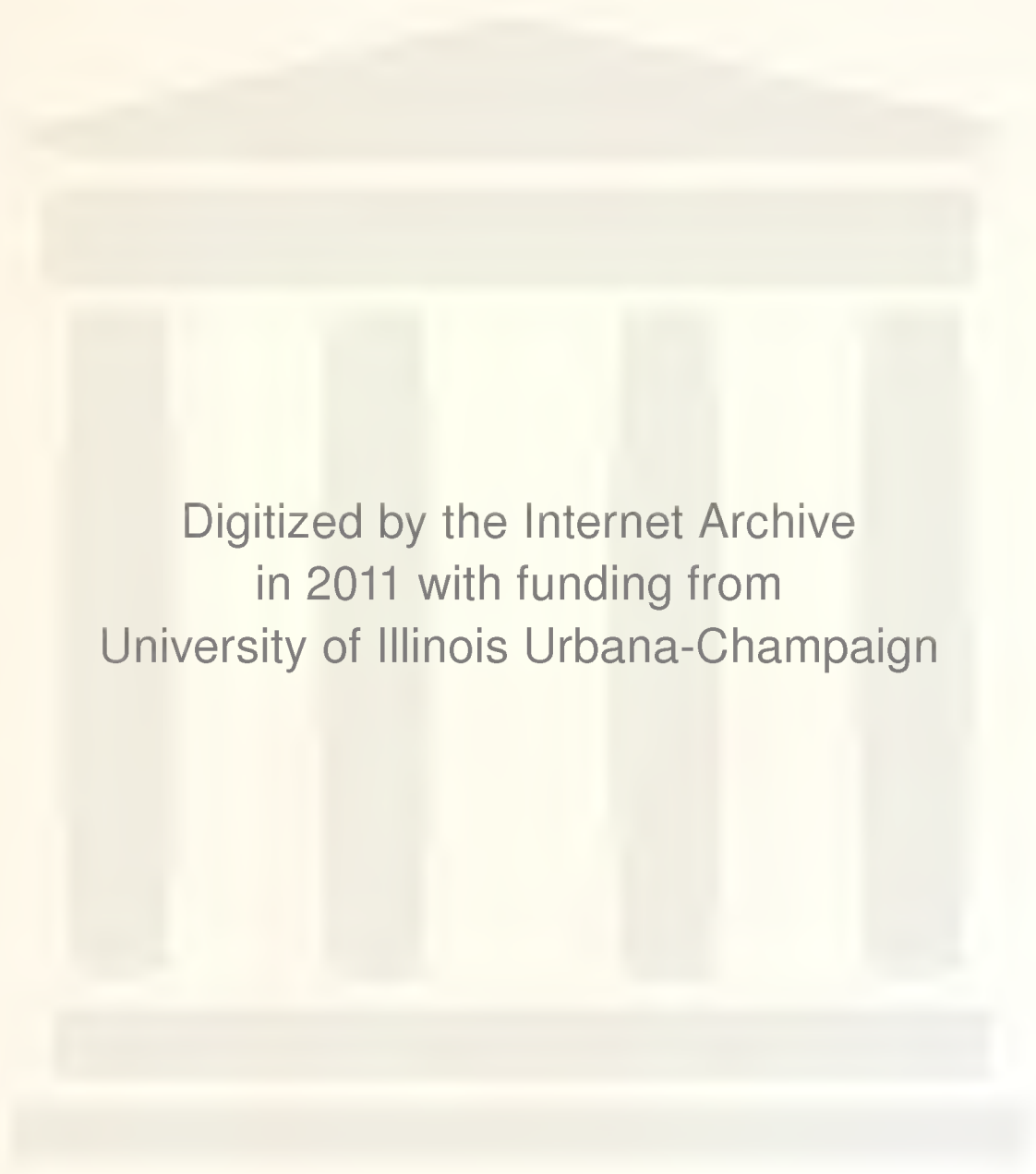


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A CONTINGENCY APPROACH TO EMPIRICALLY COM-
PARING QUARTERLY EARNINGS FORECASTS OF
STATISTICAL MODELS TO THOSE OF FINANCIAL
ANALYSTS

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#574

College of Commerce and Business Administration
University of Illinois at Urbana-Champaign



FACULTY RESEARCH PAPER

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Summary:

This study investigates the hypothesis that statistical models with quarterly earnings forecasts which are more accurate than those of financial analysts in one period are also likely to be more accurate in the succeeding period. The empirical results were consistent with this hypothesis for two quarter ahead forecasts generated by Box-Jenkins models.

I. Introduction

In recent years there has been an increased interest in the forecasting of earnings due to a widespread recognition that earning's forecasts are an important factor in investor decision making and research. This is evidenced by the fact that the Financial Accounting Standards Board has emphasized future earnings in the theoretical framework underlying their recent proposed objectives of financial reporting and elements of financial statements of business enterprises [7]. In addition the SEC has recently been considering requiring earnings forecasts in external reports [11].

Considerable attention has been given to statistical methods for predicting future earnings (see [1, 4, 5, 6, 8, 9, 12]). Of course, the accuracy of forecasts is largely dependent on the forecast method employed; and in particular, if a statistical method leads to misspecified or suboptimal forecasts then dysfunctional or suboptimal decision making can result from the use of such forecasts.

Recent research has implied that financial analysts make quarterly earnings forecasts which are superior to those of certain statistical models.¹ In particular, Brown and Rozeff [3], found financial analyst forecasts of quarterly earnings to be more accurate than those of Box-Jenkins [2], Martingale and Submartingale models. A basic reason for such results is that the analyst can utilize a broad data base in projecting earnings whereas the statistical models often utilize data relating only to past earnings.

However, the Brown and Rozeff study demonstrated the superiority of the analysis on the average for a given sample of firms; it did not

demonstrate that for all firms the analysts are superior. Nevertheless, it would seem that in no case should statistical models provide more accurate forecasts than those of financial analysts, since the analysts could choose to use the statistical models. However there is the possibility that factors such as ignorance or cost could affect such a choice. Because of this, this study investigates the possibility that, under certain circumstances, for some firms the forecasts of financial analysts might be improved upon via the use of a statistical model.

The paper is divided into three sections. Section one develops the research methodology and section two presents the empirical results. Section three presents a summary followed by conclusions.

II. Methodology

A. Notation and Terminology

In order to facilitate discussion, the following terminology and notation is used:

- (1) Success for firm i and period t ($S_{i,t}$) is used to refer to the case when a statistical model (henceforth, SM) forecast for firm i and period t is more accurate than the financial analyst (henceforth, FA) forecast for the same period.²
- (2) Failure for firm i and period t ($F_{i,t}$) is used to refer to the case when a FA forecast for firm i and period t is more accurate than the SM forecast for the same period.

3. Hypothesis

The primary hypothesis tested is:

$$H_0: P(S_{i,t} | S_{i,t-1}) = P(S_{i,t} | S_{i,t-1} \text{ or } F_{i,t-1})$$

against the alternative

$$H_A: P(S_{i,t} | S_{i,t-1}) > P(S_{i,t} | S_{i,t-1} \text{ or } F_{i,t-1})$$

The null hypothesis states that the success of a SM in period t is independent of success in the previous time period $t-1$. This hypothesis is considered because in the event that the alternative is true, it might prove useful to develop a strategy which would dictate using a SM forecast for period t if the SM produced a more accurate forecast in the previous period.

C. Sample and Statistical Models

A sample of 50 firms (Appendix) were randomly selected from calendar year-end firms whose reported quarterly earnings data was available from 1951 through 1974 (95 quarters). These observations were obtained from The Value Line Investment Survey and compustat file. The analysts' forecasts were also obtained from The Value Line Investment Survey. Eighteen two quarter forecasts were obtained commencing with the first quarter of 1970.

The historical EPS were used to generate forecasts corresponding to the FA forecasts. This was done by the following 4 forecast methods (henceforth referred to by number³).

- (1) Firm specific Box-Jenkins models using both reidentification and reestimation for each of the 18 forecasts.
- (2) (1,0,0) x (0,1,1) models with parameters reestimated each time.
- (3) (1,0,0) (0,1,0) models with parameters reestimated each time.
- (4) (0,1,1) (0,1,1) models with parameters reestimated each time.

The first of the 18 forecasts was generated from models with 76 quarters in the base period, the second forecast was generated from models with 77 quarters in the base period, etc. In each case all data in the base period was used for parameter estimation. In addition, for method 1, the models were reidentified in each base period subsequent to the first.

D. Test of the Null Hypothesis

The 18 quarter hold out period was divided into 9 separate "segments" where segment 1 contained periods 1 and 2, and segment 2 contained periods 3, 4 etc. Also within each segment the following percentages were computed:

$\%(S_2|S_1)$ and $\%(S_2|S_1 \text{ or } F_1)$. These are referred to as P_1 and P_2 respectively. Note that the null hypothesis specifies that $P_1 = P_2$ and the alternative states that $P_1 > P_2$.

Table 1 presents a description of the results of computing P_1 and P_2 for the 9 segments broken down by the four statistical models, and the 1 and 2 step ahead forecasts. In cases where the null (alternative) hypothesis is supported 0's (1's) are inserted.

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Table 1 about here
- - - - -

Note that for each model (and step ahead) there are more cases supporting the alternative than the null hypothesis. (The one exception is model 2 for the one step ahead case.) In addition under the null hypothesis the Table 1 row entries are independent and have a probability of .5 of being equal to 1. This allows binomial tests of the row margins. However since the tests are not independent, the Bonferroni Inequality [10]

is applied and each test is done at an alpha level of 1/8 of .1. Note that for the 2 step ahead forecasts the null hypothesis is rejected for models 3 and 4. Furthermore the frequencies for the 2 step ahead cases are all larger than those for the 1 step case.

E. Interpretation of the Statistical Test

The test indicated that in two cases the probability of success for a SM in period t is higher if there is no success in period $t-1$. This does not guarantee that this conditional probability of success is greater than $1/2$. Table 2 presents both the conditional (P_1) and unconditional (P_2) sample percentages for the two cases which were significant above.

Table 2 about here

Table 2 reveals that the average unconditional proportion is less than $1/2$ while the conditional proportion is greater than $1/2$. For model 3 the mean improvement is 7% (from 46% to 50.3%) and for model 4 the mean improvement is 13% (from .44% to .57%). Since the within-row elements of Table 2 are not independent (from rejection of the above null hypothesis) and their covariance structure is unknown, it is not possible to formulate an exact test of the null hypothesis that the conditional percentages are not equal to $1/2$. However, as a rough guide, Students' t tests are presented in Table 3.

Table 3 about here

The results of Table 3 tend to indicate that for model 4 P_1 is significantly greater than $1/2$.

III. Summary and Conclusions

The present study dealt with the hypothesis that, for some firms, a statistical model will generate forecasts of quarterly EPS which are more accurate than those of financial analysts. Analysis of sample data provided evidence which was consistent with such a hypothesis. This was especially true for two step ahead forecasts from univariate Box-Jenkins statistical models. In particular, it was found (for Box-Jenkins two step ahead forecasts) that forecasts which are more accurate than financial analysts in one period tend to also be more accurate in the next period.

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APPENDIX 1

Listing of Sample Firms

Abbott Laboratories
Allied Chemical
American Cyanamid
American Seating
American Smelting
Bethlehem Steel
Borg-Warner
Bucyrus-Erie
Clark Equipment
Consolidated Natural Gas
Cooper Industries
Cutler - Hammer
Dr. Pepper
Dupont
Eastman Kodak
Eaton Corporation
Federal - Mogul
Freeport Minerals Co.
General Electric
Gulf Oil
Hercules, Inc.
Hershey Foods
Ingersoll - Rand
International Business Machines
International Nickel Co.
Lamsas City Southern Industries
Lehigh - Portland
Mead Corporation
Merck and Company
Mohasco Corp.
Moore McCormack
Nabisco, Inc.
National Gypsum
National Steel
Northwest Airlines
Peoples Drug Stores
Pepsico, Inc.
Rohm and Haas
Safeway Stores
Scott Paper
Square D
Stewart - Warner
Texaco, Inc.

APPENDIX 1

(continued)

Trans World Airlines
Union Carbine
Union Oil (Cal.)
U.S. Tobacco
Westinghouse Electric
Weyerhaeuser, Inc.
Zenith Radio

Table 1

Cases Supporting the Null and Alternative Hypotheses

| Row | Origin Segment | 1,2 1 | 3,4 2 | 5,6 3 | 7,8 4 | 9,10 5 | 11,12 6 | 13,14 7 | 15,16 8 | 17,18 9 | Sum | p [*] |
|---|-------------------|----------|----------|----------|----------|-----------|------------|------------|------------|------------|-----|----------------|
| <u>One Step Ahead</u> Statistical Model | | | | | | | | | | | | |
| 1 | (1) | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 6 | .5080 |
| 2 | (2) | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 3 | .5080 |
| 3 | (3) | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 6 | .5080 |
| 4 | (4) | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 6 | .5080 |
| <u>Two Step Ahead</u> Statistical Model | | | | | | | | | | | | |
| 5 | (1) | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 7 | .1798 |
| 6 | (2) | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 7 | .1798 |
| 7 | (3) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **9 | .0040 |
| 8 | (4) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **9 | .0040 |

* Probability that N is exceeded (two-tailed)

** Significant at $\alpha/8$, where $\alpha = .1$

Table 2

Conditional and Unconditional Percentages of Success
for Models 3 and 4 (Two Step Ahead)

| Origin Segment | 1,2 1 | 3,4 2 | 5,6 3 | 7,8 4 | 9,10 5 | 11,12 6 | 13,14 7 | 15,16 8 | 17,18 9 | Average |
|----------------|----------|----------|----------|----------|-----------|------------|------------|------------|------------|-------------------|
| <u>Model 3</u> | | | | | | | | | | |
| P ₂ | .54 | .64 | .32 | .24 | .44 | .44 | .44 | .54 | .54 | .46 = \bar{P}_2 |
| P ₁ | .54 | .656 | .45 | .28 | .5 | .556 | .632 | .625 | .542 | .53 = \bar{P}_1 |
| <u>Model 4</u> | | | | | | | | | | |
| P ₂ | .46 | .54 | .32 | .32 | .46 | .38 | .5 | .52 | .48 | .44 = \bar{P}_2 |
| P ₁ | .593 | .643 | .5 | .417 | .532 | .619 | .667 | .56 | .6 | .57 = \bar{P}_1 |

Table 3

Tests of the Null Hypothesis That $P_1 = 1/2$ for
Models 3 and 4 (Two Steps Ahead)

| Model | \bar{P} | Std. Error of the Mean | t | 1 Tail Approx. Sig. |
|-------|-----------|---------------------------|------|------------------------|
| 3 | .531 | .038 | .81 | < .25 |
| 4 | .571 | .026 | 2.73 | < .025 |

Notes

¹The term "superior" is borrowed from Brown and Rozeff [3]; however superiority must ultimately depend on the utility function of the decision maker using forecasts.

²Note that accuracy under the present definition of success will be the same for quadratic or absolute error since if a given forecast is closer in absolute value it will also have a smaller squared error.

³The selection of forecast models was based on those which have been proposed in the literature as candidates for being useful in the forecasting of quarterly earnings. The history of these models is discussed by Brown and Rozeff [4].



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